Dealing with interference problems

by A. M. B. HOLLOWAY, G3VUQ*
Secretary, Interference Committee (1972-4)

THIS article summarizes the reasons, and some simple cures, for interference. References are given to other articles dealing with the problems. Finally, information is given on seeking the advice of the RSGB Interference Committee. It is hoped that those seeking advice will read this article before contacting the committee.

INTERFERENCE—THE TRANSMITTING END

It is probable that the vast majority of interference occurs because of deficiencies in the affected equipment rather than in the transmitting equipment. This does not, however, absolve the amateur from the responsibility of taking a number of steps, if only to demonstrate that he is concerned to make what efforts he can to minimize the risk of complaints.

The "clean" transmitting station

Interference may be caused by the radiation of unnecessary signals, such as harmonics of the required output frequency, or local oscillator signals in heterodyne mixer type transmitters. In vhf transmitters, unwanted harmonics of the basic low-frequency oscillator may be radiated. A further possibility is that of parasitic oscillations—these may occur on any frequency and be radiated directly, or perhaps modulate the carrier thus producing unwanted sidebands. [8, 20]

In many transmitting stations not only are unwanted signals radiated, but the wanted signal is radiated from the wrong places! The signal should be radiated from the aerial alone; not from feeders, mains leads etc, nor from the equipment itself. [6, 13, 15]

The "correct" layout of a transmitting station

It is recommended that to avoid some of the problems outlined above, all transmitting stations should conform to the general configuration shown in Fig 1. *All* individual units should be well screened, and power supply and microphone leads etc well filtered. Interconnecting leads should be short and stout (wherever possible use soldered joints). The function of each unit is as follows:

Aerial tuning unit
This is needed to match the impedance of the aerial, including feeders (which may vary widely), to that of the filter. The atu may also give added rejection to unwanted signals—this depends upon the design. It may also act as a balun, converting balanced to unbalanced feed, or isolating the aerial circuits from the transmitter circuits (a useful function—see later). When the aerial/feeder impedance is similar to that of the filter the atu may be omitted, but its other benefits will be lost.

Filters—low-pass or band-pass
A low-pass filter which cuts off at about 30MHz is recommended for hf stations. For vhf stations a band-pass filter is preferable. These filters are intended to remove as many of the unwanted signals as possible. Because the input impedance of the aerial/feeder/atu will almost certainly not be correct for the filter on frequencies other than the transmitting frequency, the attenuation may be quite different from the published figures. These assume *correct* termination of source and load on *all* frequencies. Under unfortunate circumstances a filter could even act as a matching section to an unwanted signal giving apparent gain! [9-12, 16-19]

SWR bridge
This indicates when the atu has been adjusted correctly. The bridge is placed before the filter because its detector circuit contains diodes—these may generate harmonics. When the filter is perfectly terminated the bridge should indicate an swr of 1:1. Incorrect termination could damage the filter because of high voltages which are produced—for this reason transmitted power should be kept low until the atu has been correctly adjusted. Poor swr is often wrongly blamed for apparent deficiences. [27]

Harmonic trap
This is added to give extra attenuation to a specific frequency likely to cause trouble. It should be in a screened compartment—either inside the transmitter or as an external unit.

* 2 Burlington Drive, Stockport, Cheshire SK3 8UE. (At present /MM in the Indian Ocean).

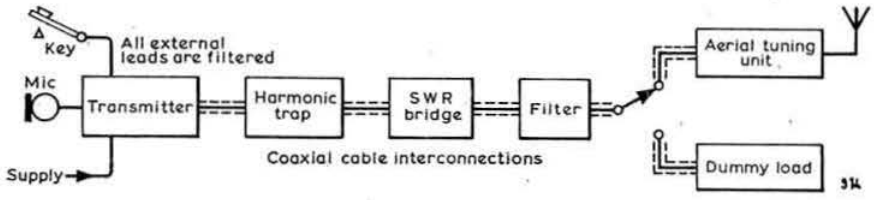


Fig 1. Recommended transmitting station layout for minimum spurious radiation

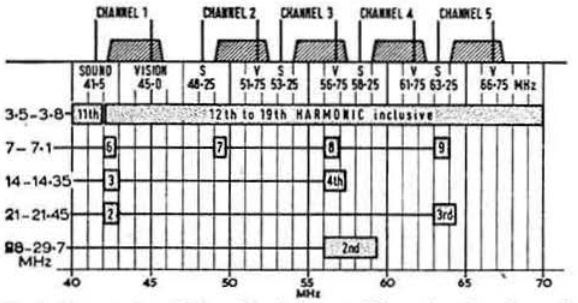


Fig 2. Harmonic relationship between hf amateur bands and tv channels in Band 1

Note that the trap should be tuned to the actual transmitter harmonic frequency and *not* to the frequency likely to be interfered with (eg 3 × 14MHz = 42MHz, so the trap must be tuned to this frequency and *not* 45MHz (tv Channel 1 vision carrier frequency)). Fig 2 indicates the harmonic relationships between the hf amateur bands and Band 1 tv frequencies. Similar charts can be drawn up for other amateur bands and tv channels.

Note that if interference occurs to tv because of *harmonic* generation this will normally affect only *one* tv channel. The tv picture will take on a "herring-bone" appearance and tuning the tv will not produce any apparent change. Altering the transmitter frequency, however, will alter the pattern.

A great deal has been written in *Radio Communication* (and other publications) on the subject of harmonic generation and radiation. With the change to uhf tv this topic is largely irrelevant to British amateurs' problems, so it is only necessary here to refer those interested to [1, 8, 10, 12, 15, 17 19, 22]

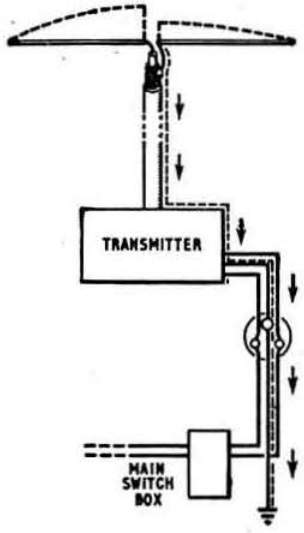


Fig 3. Due to the unbalance of aerial currents, a proportion of the current on the leg connected to the braiding flows down the feeder, through the equipment casing to earth. Should there not be a separate earth, these currents will flow via the power wiring to the house main earthing system. It is usual practice for the mains neutral to be connected to earth at the sub-station and this can result in considerable radiation on the mains distribution

Radiation of the wanted signal

Signals are often radiated from the wrong places in a transmitting station, but the amateur can do a great deal to ensure that his signals are radiated from the aerial alone. Radiation from other parts of the station (aerial feeders, mains leads etc) can cause unnecessarily high field strengths in the immediate vicinity of the equipment, hence surrounding the neighbours' tv, radio and hi-fi equipment. For this reason alone it is advantageous to mount aerials as far away from neighbours and as high as possible to "clear" surrounding objects.

Fig 4. Bifilar mains choke wound on a transistor radio ferrite rod. About 30 double turns of adequately-rated pvc-covered wire closewound on a ¼in diameter rod should suffice (dimensions and turns not critical)

The use of balanced aerials fed by balanced feeders (or via a balun) is recommended. Careful attention should be paid to the method of earthing the equipment—use of the mains earth should be avoided if possible. A separate good-quality earth is to be preferred—this should *not* be connected to the mains earth. Fig 3 shows the path which unbalanced rf currents may take in a carelessly designed system. Note that the use of a balun (at either end of the coaxial feeder) would prevent this current flow. For greater detail see [2, 6, 13]. It is advisable to use a mains filter to prevent rf energy from flowing into the mains wiring; the simplest type is the ferrite ring filter (described later), or see Fig 4.

It should also be noted that a horizontal aerial is less likely to produce strong fields around neighbouring equipment than a vertical aerial. There are two main reasons for this: many vertical aerials rely on a ground connection to form the second half of the dipole—this can induce currents in nearby conductors; and vertically-polarized signals are more likely to be picked up on nearby tv aerial downleads. In either case strong fields may be carried into the house by these conductors.

INTERFERENCE—THE RECEIVING END

If all the above steps have been taken it is reasonable to assume that the amateur station is "clean", and the field strength surrounding the station is as low as possible. It is therefore highly probable that interference is due to inadequacies in the design (or operation) of the affected equipment

There are two distinct classifications:

(*a*) Interference to tv or radio—tvi or bci;

(*b*) Interference to audio-only equipment—afi.

In the first case these services are "protected"—the equipment is designed for rf reception and the services of the Post Office Interference Branch may be called upon in cases of interference to *authorized* broadcast transmissions. This

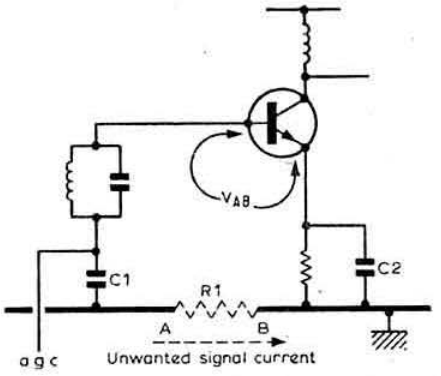


Fig 5. Simple example of how "braid current" can enter any stage of a piece of electronic equipment. Current flowing through the resistive earth path (R1) causes an interfering voltage V_{AB} to be fed to the base-emitter junction via C1 and C2

applies only to those transmissions which are intended to be received in a particular area—ie where the receiver is within the official service area of the transmitter.

In the second case the audio equipment is "by definition" at fault since it is neither designed nor licensed to act as a radio receiver. It is therefore not "protected" against interference.

TVI and bci

In the majority of cases of tvi or bci which occur nowadays, it is unlikely that harmonic production from amateur signals is taking place. Interference usually affects all tv channels (particularly on uhf sets), and is not affected significantly by the frequency of the interfering signal. This type of interference is caused either by direct reproduction of the signals on vision, by detection on either vision or sound, or by cross-modulation which may occur in any stage of the affected equipment. It is, incidentally, probably true to say that the least likely place for the interference to occur is in the tuner itself, since this is the one stage of a set which still possesses a modicum of screening and a stout earth path. Providing a "better" signal to the receiver is unlikely to have any beneficial effect in such cases. [24]

The most common method by which the interfering rf energy enters the equipment is in the production of "braid currents" in the aerial downlead. These currents flow through the earthy part of the set, causing rf voltages to be developed across points which should be at equal potential. Colour decoder circuits are particularly susceptible to transmissions on the 3·5 and 7MHz bands (colour sub-carrier is on 4·43MHz). Fig 5 shows a simple representation of this interference mechanism. Braid current mechanisms are dealt with in more detail in [21].

Braid-breaker filters

Fortunately the cure for braid current induced problems is usually simple and cheap (it is a source of amazement to the Interference Committee that the manufacturers of tv sets seem so unwilling to take action). Fig 6 shows a combined uhf high-pass filter and braid-breaker circuit. This circuit, slightly modified, could be used in place of existing uhf tv aerial isolator panels (but should only be used by the amateur as an add-on unit). This gives useful attenuation up to about 200MHz and, due to the low-value coupling capacitors, effectively breaks the feeder from the tv at hf amateur frequencies. Construction of this filter can be left to the ingenuity of the reader—provided the leads are kept short the attenuation to uhf signals is negligible. [21, 25]

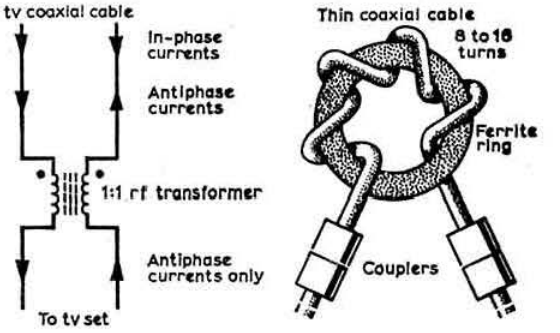
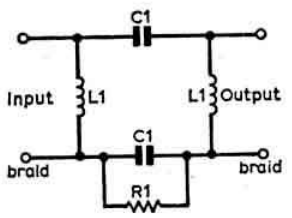


Fig 7. Ferrite ring filter (suitable for all frequencies, radio, tv, and hi-fi, mains etc). The tv feeder is made into a coaxial rf choke. In-phase currents are blocked while anti-phase currents pass unhindered

Where vhf tv and radio sets are affected, the cause may well still be braid currents, but the above solution cannot be applied because it is not possible to break the braid effectively to hf amateur frequencies yet produce minimal attenuation to vhf. Consequently a different approach is necessary—some form of 1:1 rf transformer is required. This can take several forms, the most simple being the ferrite ring filter (Fig 7). This consists of a few turns of the aerial feeder round a ferrite ring (such as the Mullard FX1588). Usually about 8 or 10 turns will suffice, but it must be emphasized that neither the number of turns nor the grade of ferrite used is critical. *This device is wideband and is equally suitable for use on uhf tv, vhf tv or radio, hi-fi, mains filters etc.* Alternatively various



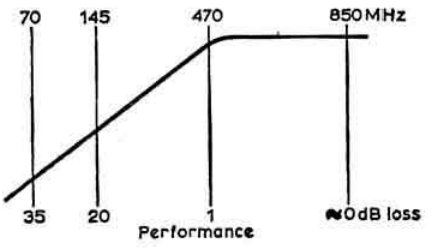


Fig 6. (Left) Circuit of uhf tv braid-breaker. L1 is four turns 24swg ¼in inside diameter. C1 is 5·6pF small disc or tubular. R1 is about 1MΩ. Physical construction must conform to good uhf practice to minimize loss, but values are not critical. (Right) UHF tv filter performance

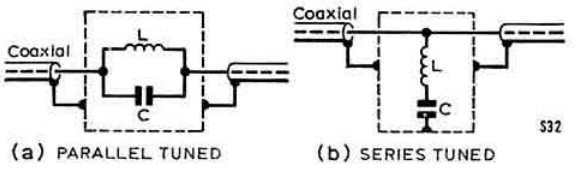


Fig 8. Single-frequency traps. (a) Parallel tuned. A tunable trap of this type is a valuable aid to diagnosis. Suggested values are: C, 75pF variable; L, 10t 16swg ¼in dia 1in long for 25/70MHz, 22t 24swg ¼in dia 1in long for 12/35MHz. (b) Series tuned. This type of trap must be used with care—in cases where interference is picked up on the coaxial cable braiding, this type of trap may worsen the situation

other types of transformer may be constructed using either purpose-made balun cores, or any other scraps of ferrite found in the junk box. For details see [21].

In each of the above devices the intention is to choke off, or completely break the path of, interfering rf currents in the braid of the aerial downlead. Except in the case of the filter in Fig 6 they are not frequency-dependent filters to signals being passed from the aerial itself. Where the aerial is able to pick up significant amounts of interfering signals it may be necessary to back up the braid-breaker filter with a filter designed to pass the wanted signal and stop the interfering signal(s).

It is not proposed to go into detail on the various types of receiver high-pass filters at this point—readers interested should consult [4, 7, 12].

Traps

Where it is necessary to fit a filter to allow the wanted signals to pass and prevent the passage of unwanted signals, it will be found that as a general rule it is better to use a tuned trap (to stop the unwanted signal) than a pass filter (for the wanted signal). This rule holds, for simple filters, except when the two signals are several octaves apart, when either type will have similar effect. The reason for this is simply that a tuned stop filter will give greater attenuation to the unwanted signal than the out-of-band response of the pass filter.

This is a useful fact in practice, since it enables the filter to be set up before installation. If a filter is intended, for example, to prevent a 2m signal from entering a uhf tv receiver, then the filter is easily adjusted on the amateur's own 2m receiver to remove (or at least greatly attenuate) a beacon or other local 2m signal. Note that this method of tuning is valid only for simple trap filters of the form shown in Figs 8–12. When complex filters are used the terminations (source and load) can seriously affect filter performance—see earlier comment under **Filters**.

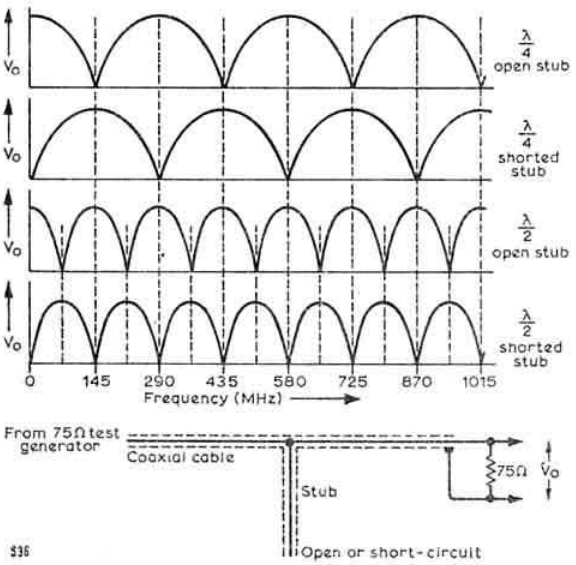


Fig 9. Output level/frequency for various 145MHz stubs

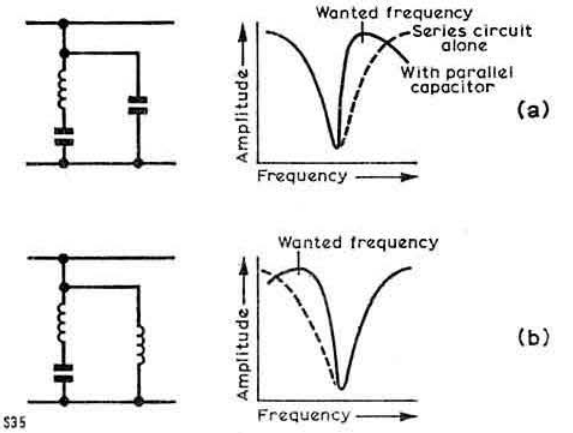


Fig 10. (a) Use of capacitance across a trap or λ/4 stub sharpens the response on the high-frequency side. (b) Use of inductance across a trap or λ/4 stub sharpens the response on the low-frequency side.

Stubs

Coaxial cable stubs are a popular form of trap filter because they are simple and cheap to make, though sometimes troublesome to adjust. They do, however, have a potential shortcoming—their overtone responses. These are shown graphically in Fig 9. It will be seen that if such a stub filter were used to prevent a 2m signal from entering a uhf tv set, it is quite possible that some of the wanted uhf signals would also be attenuated. There are ways of shifting the overtone responses (by various forms of end-loading), but a simple single-tuned trap (Fig 8) will produce similar attenuation without suffering from the overtone problem. In practice the trap is also easier to adjust.

How much attenuation?

The LC ratio of traps may be important. Parallel-tuned traps have narrowest bandwidth and least attenuation with a low LC ratio, whereas for the same performance the series-tuned trap would have a high LC ratio. Some compromise between attenuation and bandwidth may be necessary when the two signals are close together. Additional circuit elements may be used to "sharpen" the side response of a trap (or stub) as shown in Fig 10. As a general rule, a single trap or stub can be expected to give around 30dB attenuation on its

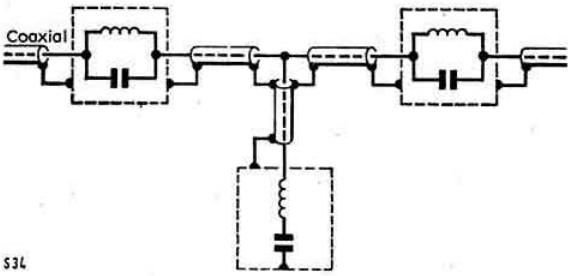


Fig 11. Single-frequency traps cascaded to increase attenuation. These may be enclosed in one case (with each section screened)

tuned frequency. Greater attenuation can be obtained by cascading traps or stubs as in Figs 11 and 12.

An interesting combination of these techniques is shown in Fig 13. This filter is designed to reject 432MHz signals but have little or no effect on signals from 470MHz up. The attenuation may vary between about 60dB (when the traps are tuned to the same frequency) and 40dB (when the traps are stagger-tuned to cover the 70cm band).

Logical approach to tvi diagnosis

Fig 14 sets out a method of dealing with tvi diagnosis. This may be found helpful in difficult cases where the reason for the trouble is not immediately obvious.

AFI

In the majority of cases of afi the interfering signal is found to be entering the audio equipment by means of its interconnecting leads—the most common route being the loudspeaker leads on a typical stereo installation. In some cases

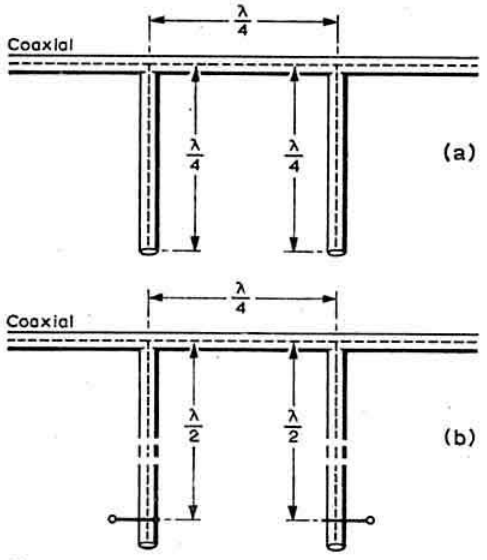


Fig 12. Two stub filters capable of providing a notch of about 70 or 80dB at centre frequency. (a) Open-circuit quarter-wave stubs. (b) Version using short-circuit half-wave stubs with movable "pin" short-circuiting device

the mains lead is responsible. The interference is generated by detection within the amplifier. The rf energy may be fed direct to the amplifier input (via, for example, the internal negative feedback line from the loudspeaker terminal), or it may enter any stage by the same type of mechanism as the braid current described above (Fig 5). The first type of problem could be cured by decoupling the loudspeaker or other leads with disc ceramic capacitors of suitable value (around 100 to 10,000pF). However, this would not deal with the braid-current effect. Again the ferrite ring filter provides a simple answer: the offending leads (loudspeaker, mains or interconnecting) are wrapped into a few turns round a ring core as in Fig 7. Other approaches are possible, but involve considerably more effort [23].

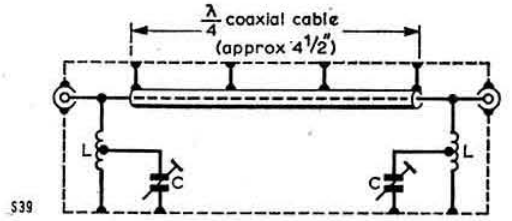


Fig 13. 70cm trap for use with uhf tv sets. L is 8t 20swg ¼in inside diameter, stretched to 0·6in long, centre-tapped. C is 2·5–6pF low inductance trimmer. The two tuned circuits must be screened from each other or kept well apart. The braid of the cable must be soldered to the box at several points, as shown. All leads must be very short

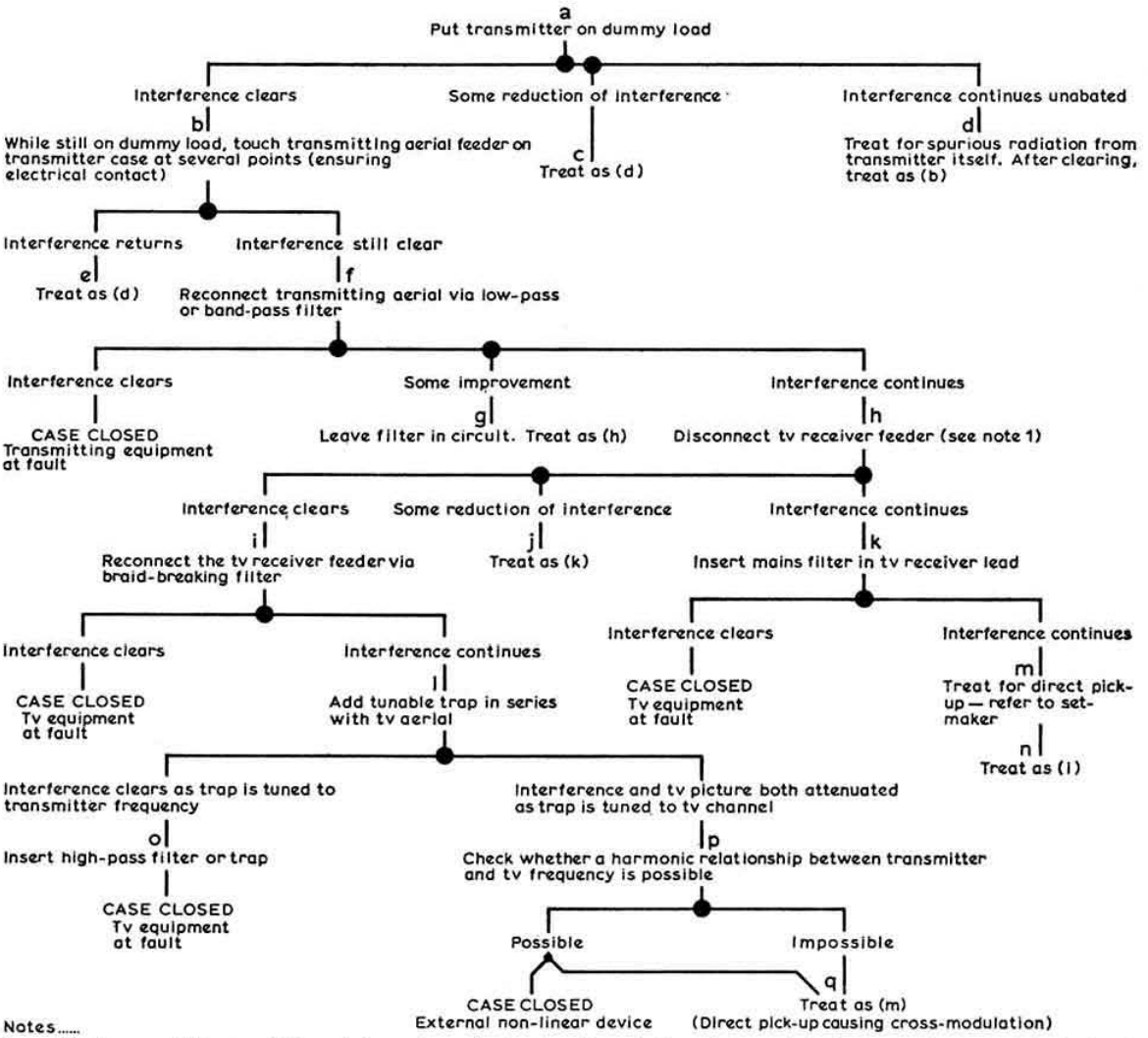
The amateur's best friend

There is no doubt that the ferrite ring core is the most useful device in the amateur's anti-interference armoury. A major advantage in using such devices is that in the majority of cases the leads to be filtered do not even have to be cut and the filters are used external to the equipment only. They are easily removable, and the resale value of the equipment is unaffected. If rings are not available, ex-transistor radio aerial rods are a good second best in many cases. The grade of ferrite is unimportant and the number of turns not critical. They may be used for receiving or transmitting purposes [2, 21, 23].

Interference to amateur reception

This is an increasing problem. Many amateurs complain of interference (especially on 160m and 80m) from tv receivers. This is largely a problem for the manufacturers to deal with, but again, in many cases, simple measures may produce a considerable improvement [14].

The comments made above with regard to radiating signals from the aerial alone (use of baluns etc) also apply in the reverse direction. If the aerial alone receives the signals, careful positioning will minimize local interference pick up. Similarly, measures taken to prevent signals on amateur frequencies from entering tv sets will reduce the likelihood of the sets *radiating* rf energy on those frequencies. The use of braid-breaker filters is recommended for this purpose. Interference from other sources, such as electric motors, thermostats and other electrical machinery can be combated by the use of mains filters, decoupling capacitors etc. Some useful types are shown in Fig 15.



Notes.....

1 ..... Interference will have a different character on tests when the aerial is not connected, due to the absence of the tv signal with which to beat or cross-modulate.

2 ..... The effect of cross-modulation is usually different from other forms of interference. It does not produce a crosshatch pattern on the television picture.

3 ..... When an unwanted signal is on or near the television channel frequency crosshatching does not alter with tv tuning. When crosshatching does change with receiver tuning it is due to pick-up on frequencies outside the television channel (e.g. image, i.f., etc).

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Fig 14. Chart for the diagnosis of tvi

Try the obvious

Before any filters are tried, one simple test should be carried out. Operate the affected equipment with the aerial downlead *well removed* from the set. In the case of afi remove the loudspeaker leads (or suspect input leads) and use headphones or loudspeakers on *short* leads. If interference still occurs it is apparent that no amount of filtering of the leads will effect a cure. Close attention should then be paid to other routes by which the energy might be entering the equipment. Filter the mains leads and check for the presence of other conductors which may be radiating rf energy into the equipment. Electrical conduit, gas and water pipes etc should all be treated as suspect. Try earthing the braid of the aerial feeder where it enters the room.

If a filter does not work

If removing leads effects a cure, but a filter does not appear to work, two questions should be asked:

(*a*) Is the right type of filter being used?

(*b*) Is it being used properly?

The answer to the first should be apparent if the above information has been understood. The answer to the second

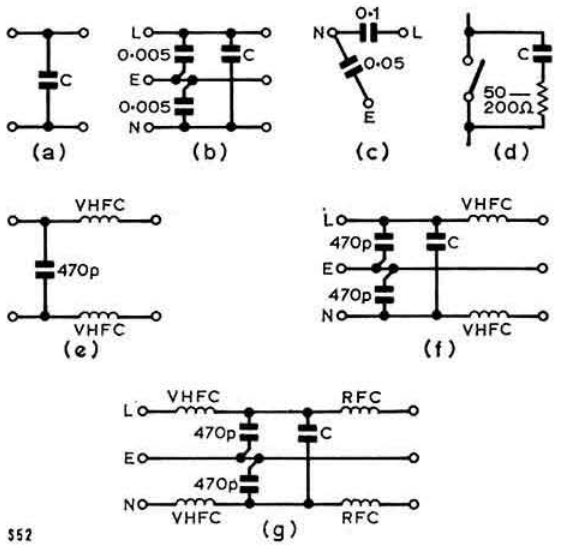

Fig 15. Some common forms of interference-suppression filters (from *Radio Servicing Pocket Book.*) (a) For two-core cable appliances. (b) For three-core appliances. (c) For three-pin sockets. (d) For thermostats. Types (e) and (f) are vhf types intended for use at television frequencies. Type (g) is a combined mf/hf/vhf filter. The value of C may vary between 0·01 and 0·5μF. On type (c) the values given are the largest permissible. All capacitors must be rated for ac. L line, N neutral, E earth

is a little more complicated. For many years the rule has been "put the filter as close to the object being filtered as possible". This does not always hold, especially with braid-breaker filters. Since the function of the filter is to open-circuit the braid *current*, a high braid *voltage* might result. This would produce a field surrounding the filter, and this field might break through directly into the equipment. In such a case it is well worth trying the filter some distance from the set (say, 2 or 3m), perhaps in conjunction with a separate earth to the braid. This action alone has been known to cure not only tvi on the set to which it was connected, but also bci to a portable radio in the same room.

Warning!

The Interference Committee strongly advises against any amateur carrying out internal modifications to any equipment not his own. This will invalidate guarantees, and the amateur may well be held responsible for any faults which occur at a later date. It is the responsibility of the set owner/dealer/manufacturer to repair faulty equipment, and every effort should be made to ensure that these are the people who deal with the matter.

THE RSGB INTERFERENCE COMMITTEE

The above information forms the basis of the *technical* cure for a high percentage of interference problems. Many problems are in fact *social* rather than technical and this is the subject of a separate article.

The committee is willing to help with problems whenever possible, but it should be remembered that it is important that all the facts are known. The appendix gives some of the questions to which answers are often needed before a case can be dealt with effectively. Anyone needing the help of the committee should write (c/o RSGB HQ) giving answers to these questions, and any other information which might be helpful, and making sure that copies of any correspondence with other interested parties is enclosed.

What will happen

A reply will be sent by a committee member giving his appraisal of the situation and a recommended course of action; further correspondence, if necessary, should go direct to the committee member. It will greatly assist the effectiveness of advice if the final results are made known to the committee. At present, only a minority acknowledge advice, and only a small minority make results known.

What will NOT happen

Some members writing to the committee appear to expect that within 24 hours of receiving the request for help, the RSGB will despatch expensive test equipment and highly qualified "interference men" to deal with the problem on site! Needless to say this is not so. The interference problem is, and will remain, largely a problem for the individual, or local group, to deal with. The Interference Committee can only offer advice and moral support in most cases. It is up to the *member* to deal with *his* problems—the job of the RSGB should be to attempt to prevent the troubles from arising in the first place.

Information gathering

When a problem has been dealt with, with or without assistance from anyone, it is of interest to everyone to know this fact. Consequently, a short note to the committee giving any necessary details (information on unusual cures etc) would be greatly appreciated. It should be *clearly* stated that the letter is for "information only". This information will form an invaluable guide to the scale of the problem, the frequency with which standard cures are effective, and the degree of success (or failure) of RSGB efforts to combat the problems.

The survey

As an "instant indicator" the committee decided to carry out a survey. This is included in this issue of *Radio Communication*, and ALL members are urged to return the completed questionnaire immediately.

Acknowledgement

The author wishes to thank all those (far too numerous to mention) who have, during the past years, contributed articles and information on interference matters; without their efforts a compilation of this nature would not have been possible.

BIBLIOGRAPHY

Articles from "Radio Communication"

A list of some of the articles published in *Radio Communication* containing information, practical or theoretical, on the subject of interference follows. Close study may indicate a degree of disagreement between authors, but this is to be expected with a subject where local circumstances vary widely. It should also be noted that during the period

covered by this list television standards and amateur operating techniques have changed considerably.

Where necessary a brief explanatory note is given with each reference.

[1] Mar 1966 "The effective use of low-pass filters for reducing tvi", G. P. Anderson, G2QY. (Importance of adequate screening etc).

[2] July 1966 "The G3HZP balun", H. D. James, G3HZP. (HF transmitting balun using ferrite ring cores).

[3] Dec 1966 "QRM—the cure", B. Priestley, G3JGO. (Amateur-to-amateur interference).

[4] Apr 1967 "Three cases of tvi", D. A. Pilley, G3HLW. (VHF tv high-pass filter).

[5] May 1967 "The tvi problem on 4m", M. Gibbings, G3FDW. (General).

[6] June 1967 "Co-ax or twin?" E. M. Wagner, G3BID. *Letters to the Editor*. (Feeder radiation).

[7] Aug 1967 "High-pass filter design for tv protection against hf transmissions", W. J. M. McKinney, GI3TZB.

[8] Jan 1969 "SSB and interference", B. Priestley, G3JGO. (Transmitter design notes).

[9] Feb 1969 *Technical Topics*, J. P. Hawker, G3VA. (Filter mismatch—absorptive filter).

[10] May 1969 "How much harmonic?", Kay Priestley, G3XIW. (Filter notes).

[11] July 1969 "Simple filters for transmitters on 144 and 432MHz", G. R. Jessop, G6JP. (VHF band-pass filters—see also December 1969, [16] and [18]).

[12] July 1969 "Which filter?", Kay Priestley, G3XIW. (Low-pass and high-pass designs).

[13] Oct 1969 "Television interference—its causes and remedies", D. M. Thomas, GW3RWX. (General).

[14] Jan 1970 "Interference and the amateur", E. M. Wagner, G3BID. (Power-line interference etc).

[15] Feb 1970 "Where tvi is a problem", D. G. Pinnock, G3HVA. (General).

[16] Sept 1970 "Simplified stripline filter for 144MHz", P. T. Bellamy. (Bandpass filter).

[17] Mar 1971 "High attenuation low-pass filter for hf band use", J. W. Shelley, G3YFZ.

[18] June 1971 "A compact bandpass filter for 144MHz", G. R. Jessop, G6JP.

[19] Aug 1971 "Modern filter design for the radio amateur", W. H. Allen, G3UJ.

[20] Oct 1971 *Four metres and down*, J. Hum, G5UM. (Spurious signals from 144MHz transmitters).

[21] Nov 1972 "Practical braid-breakers using stock materials", I. Jackson, G3OHX. (Why they work and how to make them).

[22] Mar 1973 "Improved harmonic attenuation in hf transmitters", Dr A. Gschwindt, HA5WH. (Modifications to output matching networks).

[23] Apr 1973 "Audio frequency interference (afi)", P. W. Waters, G3OJV. (General).

[24] Dec 1973 "UHF television interference", I. Jackson, G3OHX. (Effects of signal strength etc).

[25] Feb 1974 *Technical Topics*, J. P. Hawker, G3VA. (Printed circuit uhf filter).

[26] Nov 1974 "A balun transformer for 50 and 75 ohm lines", Z. T. Chowaniec, G3PTN.

[27] June 1974 *Technical Topics*, J. P. Hawker, G3VA. (Effects of swr).

Useful hints may also be found in the *Technical Topics* section of the following issues: Jan and Mar 1969, Dec 1970, July 1971, July and Oct 1972, June 1974. A series of "TVI Tips" (compiled by B. Priestley, G3JGO) was run during 1970.

Interference statistics appear either as separate articles, or as part of *Technical Topics* in: Oct 1969, Oct 1970, Dec 1971, Nov 1972, Jan 1974, Sept 1974.

Other RSGB publications

Television Interference Manual, B. Priestley, G3JGO. (Largely a digest of information published in *Radio Communication* up to about 1971).

Amateur Radio Techniques, J. P. Hawker, G3VA. (Many useful circuits, devices etc).

Radio Communication Handbook. (Much information, including a chapter on interference).

Further references

Radio Amateur's Handbook. (ARRL) (Much information, including interference advice).

Many other publications for the radio amateur have carried articles dealing with interference problems, transmitting and receiving filters etc. Readers are advised to study the indices of all magazines carefully. A useful set of low-pass filters (one for each band, 1·8 to 28MHz) was published in *Ham Radio* Mar 1974 (with correction in Dec 1974).

APPENDIX

Information to be supplied when the advice of the Interference Committee is sought

(1) Date, name, callsign, address, telephone number.
(2) Affected tv channel numbers (if tvi).
(3) Diagram showing:
  (*a*) position of transmitter and aerials;
  (*b*) position of affected equipment and aerials;
  (*c*) approximate distances involved;
  (*d*) direction from which affected tv signals are received.
(4) Description of transmitting station, aerials etc.
(5) Which frequencies cause trouble? Which transmitting modes cause trouble?
(6) Are the following used: (*a*) an atu?, (*b*) an swr bridge?, (*c*) a filter?, (give details).
(7) Has any part of the member's, or his neighbours' equipment changed recently?
(8) Make and model number of affected equipment.
(9) Has the Home Office (or other authority) become involved? Give details in chronological order.
(10) Are complainants likely to be co-operative? Describe their attitude on this and other domestic matters.
(11) Which articles or references have been studied?
(12) What action has been taken? Give full details.
(13) Supply copies of all correspondence to date—these will be returned if requested.

Information supplied is treated in confidence.